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ABSTRACT

This general mathematics guide, for use in grades 9-12, is one of a series of guides, K-12, that were developed by teachers to help introduce environmental education into the total curriculum. Since the nature of mathematics is abstract, students do not learn mathematics from ecology, nor ecology from mathematics. But, by observation and manipulation of environmental data, the student may inductively discover a principle in mathematics which can be reached deductively. The purpose of this booklet is to make an attempt to bridge mathematics and ecology. The guide is a supplementary handbook of ecologically-oriented mathematics exercises, designed to be self-contained and complete with answers. The exercises are built around 12 major environmental concepts that form a framework for each grade or subject area, as well as for the entire K-12 program. Each exercise is indexed by mathematical area and major mathematical concept and cross indexed by environmental concepts. Each lesson deals with a mathematical concept and its applications to an environmental problem. Further, each lesson offers subject area integration, subject area activities, interdisciplinary activities, cognitive and affective behavioral objectives, and suggested references and resource materials. (Author/TK)

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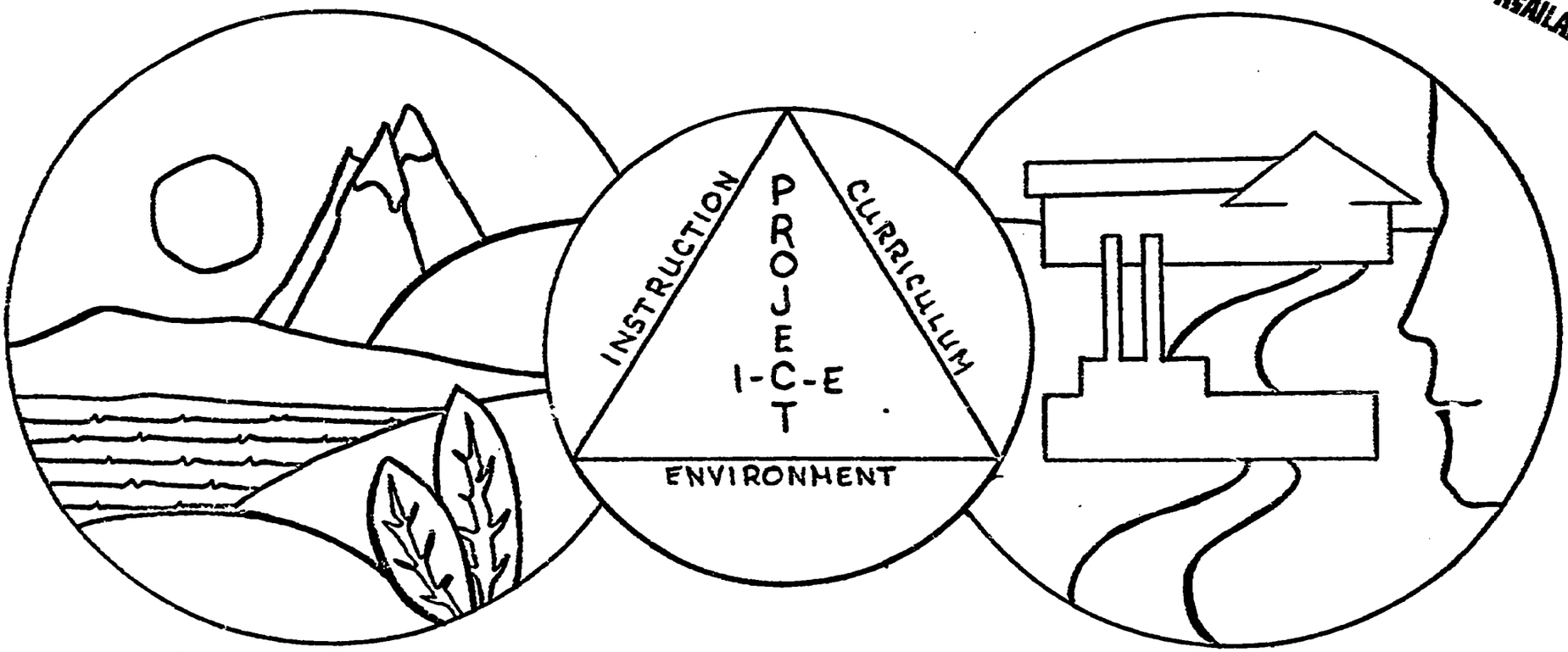
ENVIRONMENTAL EDUCATION GUIDE



GENERAL MATH 9-12

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FORWARD TO PROJECT I-C-E ENVIRONMENTAL EDUCATION GUIDES

In 1969, the First Environmental Quality Education Act was proposed in the United States Congress. At the time of the introduction of that legislation, I stated:

"There is a dire need to improve the understanding by Americans of the ominous deterioration of the Nation's environment and the increasing threat of irreversible ecological catastrophe. We must all become stewards for the preservation of life on our resource-deficient planet."

In the three years since the Environmental Education Act was passed by the Congress, much has happened in the United States to reinforce the great need for effective environmental education for the Nation's young people. The intensive concern over adequate energy resources, the continuing degradation of our air and water, and the discussion over the economic costs of the war against pollution have all brought the question of the environmental quality of this nation to a concern not merely of aesthetics but of the survival of the human race.

The intense interest by the public in the quality of our lives as affected by the environment clearly indicates that we cannot just use incentives and prescriptions to industry and other sources of pollution. That is necessary, but not sufficient." The race between education and catastrophe can be won by education if we marshall our resources in a systematic manner and squarely confront the long-term approach to saving our environment through the process of education.

As the incessant conqueror of nature, we must reexamine our place and role. Our world is no longer an endless frontier. We constantly are feeling the backlash from many of our ill-conceived efforts to achieve progress.

Rachel Carson's theme of "reverence for life" is becoming less mystical and of more substance as our eyes are opened to much of the havoc we have wrought under the guise of progress. A strong commitment to an all-embracing program of environmental education will help us to find that new working definition of progress that is a pre-requisite to the continued presence of life on this planet.

- Senator Gaylord Nelson

GENERAL MATHEMATICS PREFACE

This is a supplementary handbook of ecologically-oriented mathematics exercises, designed to be self-contained and complete with answers. The problems in this handbook are primarily designed for General Mathematics or Applied Mathematics in Grades 9 thru 12. They are indexed by mathematical area and major mathematical concept and cross-indexed by environmental concepts. Each lesson deals with a mathematical concept and its applications to an environmental problem. The material in this booklet has been written and revised by mathematics teachers for use by mathematics teachers.

Since the nature of mathematics is abstract, students do not learn mathematics from ecology, nor ecology from mathematics. But, by observation and manipulation of environmental data, the student may inductively discover a principle in mathematics which can be reached deductively. Also, by using environmental data, the student can exercise learned mathematical skills.

Thus, there is a need to bring ecology into mathematics and mathematics into ecology. The purpose of this booklet is to make an attempt to bridge that gap for the high school mathematics student. We hope you will find them useful and worthwhile in teaching some of the important ecological ideas to our young people. It is these young people, after all, who will play a major role in the saving of our environment.

YOUR TASK AND RESPONSIBILITY IS TO USE THESE EXERCISES WHEREVER THEY MIGHT APPLY!

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DIRECTIONS FOR USING THIS GUIDE

This guide contains a series of episodes (mini-lesson plans), each containing a number of suggested in and out of class learning activities. The episodes are built around 12 major environmental concepts that form a framework for each grade or subject area, as well as for the entire K-12 program. Further, each episode offers subject area integration, multi-disciplinary activities, where applicable, both cognitive and affective behavioral objectives and suggested reference and resource materials useful to the teacher and students.

1. This I-C-E guide is supplementary in design--it is not a complete course of study, nor is its arrangement sequential. You can teach environmentally within the context of your course of study or units by integrating the many ideas and activities suggested.

2. The suggested learning activities are departures from regular text or curriculum programs, while providing for skill development.

3. You decide when any concepts, objectives, activities and resources can conveniently be included in your unit.

4. All episodes can be adapted, modified, or expanded thereby providing great flexibility for any teaching situation.

5. While each grade level or subject area has its own topic or unit emphasis, inter-grade coordination or subject area articulation to avoid duplication and overlap is highly recommended for any school or district seeking effective implementation.

This total K-12 environmental education series is the product of 235 classroom teachers from Northeastern Wisconsin. They created, used, revised and edited these guides over a period of four years. To this first step in the 1,000 mile journey of human survival, we invite you to take the second step--by using this guide and by adding your own inspirations along the way.

PROJECT I-C-E TWELVE MAJOR ENVIRONMENTAL CONCEPTS

1. The sun is the basic source of energy on earth. Transformation of sun energy to other energy forms (often begun by plant photosynthesis) provides food, fuel and power for life systems and machines.

2. All living organisms interact among themselves and their environment, forming an intricate unit called an ecosystem.

3. Environmental factors are limiting on the numbers of organisms living within their influence. Thus, each ecosystem has a carrying capacity.

4. An adequate supply of clean water is essential to life.

5. An adequate supply of clean air is essential for life.

6. The distribution of natural resources and the interaction of physical environmental factors greatly affect the quality of life.

7. Factors such as facilitating transportation, economic conditions, population growth and increased leisure time influence changes in land use and population densities.

8. Cultural, economic, social, and political factors determine man's values and attitudes toward his environment.

9. Man has the ability to manage, manipulate and change his environment.

10. Short-term economic gains may produce long-term environmental losses.

11. Individual acts, duplicated or compounded, produce significant environmental alterations over time.

12. Each person must exercise stewardship of the earth for the benefit of mankind.

A "Concept Rationale" booklet and a slide/tape program "Man Needs His Environment" are available from the I-C-E RMC to more fully explain these concepts.

CROSS REFERENCE OF MATH CONCEPTS TO ENVIRONMENTAL CONCEPTS

Major Mathematical Concept	Environmental Concept	Page Number
GM-1 Fractions	1	7
GM-2 Multiplication of Whole Numbers	3	13
GM-3 Road Map Use and Arithmetic Concepts	9	19
GM-4 Percentage	7	23
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E. S. E. A. Title III – PROJECT I-C-E 59-70-0135-4

Environmental:

Integrated with:

CONCEPT NO. 1 - Energy

SUBJECT General Math (Cross Ref: Home Ec.)

ORIENTATION Energy

TOPIC/UNIT GM-1 Fractions

BEHAVIORAL OBJECTIVES

Cognitive:

Analyze the statement, "The sun's energy provides food for man," by study of a common recipe. Make calculations to increase a simple recipe to provide sufficient servings for a given number using fractions.

Affective:

Be sympathetic toward the problems of other regions of the country because of his understanding of the interdependence of one region to another.

Skills Used:

1. Multiplication of fractions

STUDENT-CENTERED LEARNING ACTIVITIES

In-Class:

A. Worksheet GM-1A on problems dealing with recipes--multiplying recipes by fractions and whole numbers.
B. From which states or nations would the ingredients be obtained?
C. How did the energy of the sun in this recipe provide energy for man?

Outside or Community:

A. Locate a recipe for a good punch drink suitable for a school party. Increase it to fit your class enrollment.
B. Visit a supermarket. List ten unusual foods found there and tell from which country they were obtained.
C. As an extra project, students may wish to determine the cost of moving foods, in Section "B" from their home country to our tables.

SUGGESTED RESOURCES	CONTINUED OR ADDED LEARNING ACTIVITIES
Publications: Cook Books World Maps **Audio–Visual:** Cooking: Measurements, BAVI, #0473, 10 minutes. Film: Alice in Numberland, BAVI, #5370, color, 14 minutes. **Community:** Home Economist	

1. Here is a recipe for chocolate chip oatmeal cookies.

1 c.	shortening
3/4 c.	brown sugar
3/4 c.	white sugar
2	eggs
1 t.	soda
1 t.	salt
1 1/2 c.	flour
1 t.	hot water
1 c.	nuts
1	package semi-sweet chocolate bits
2 c.	oatmeal
1 t.	vanilla

a. Double the recipe.
b. Triple the recipe.
c. Give one-half the recipe.
d. Give one-fourth the recipe.

---

2. This is a recipe for dumplings for stewed chicken.

3/4 c.	sifted flour
2 1/2 t.	baking powder
1/2 t.	salt
1	egg
1/3 c.	milk

a. Double the recipe.
b. Triple the recipe.

---

3. The following recipe for sauerbraten serves four.

2 lb.	beef, chuck
1 c.	vinegar
2	bay leaves
6	peppercorns
8	cloves
1/4 t.	allspice
1/4 c.	flour
3/4 t.	salt
3 T.	shortening
2 t.	sugar

a. Give the recipe for serving two.
b. Give the recipe if you want to make just one serving.

---

4. Mrs. Dobreske wanted to use a recipe she found in a book. The book stated that the recipe served four. Here is the recipe:

PAN-FRIED LIVER

3/4 lb.	liver
3/8 c.	flour
1/2 t.	salt
1/8 t.	pepper
3 T.	shortening

a. She wants to make enough pan-fried liver to serve twelve people. How much of each ingredient should she use?
b. How much of each ingredient should she use to serve eight people?

---

5. Yummy, yummy, good for the tummy!! This recipe for Yummy Chocolate Squares from Better Homes and Gardens Junior Cook Book, page 60, makes 36 generous sized squares.

1 lb.	marshmallows
1 c.	broken walnuts
3 T.	butter
1 c.	crisp rice cereal
1/2 t.	salt
1 t.	vanilla
8 oz.	semi-sweet chocolate

a. Cut the recipe in half.
b. Take one-fourth of the recipe.

Answers to GM-1A

1. a. Double Recipe

2 c.	shortening
1 1/2 c.	brown sugar
1 1/2 c.	white sugar
4	eggs
2 t.	soda
2 t.	salt
3 c.	flour
2 t.	hot water
2 c.	nuts
2	pkg. semi-sweet choc. bits
4 c.	oatmeal
2 t.	vanilla

1. b. Triple Recipe

3 c.	shortening
2 1/4 c.	brown sugar
2 1/4 c.	white sugar
6	eggs
1 T.	soda
1 T.	salt
4 1/2 c.	flour
1 T.	hot water
3 c.	nuts
3	pkg. semi-sweet choc. bits
6 c.	oatmeal (or 1 qt. 1 pt.)
1 T.	vanilla

1. c. One-half Recipe

1/2 c.	shortening
6 T.	brown sugar
6 T.	white sugar
1	egg
1/2 t.	soda
1/2 t.	salt
3/4 c.	flour
1/2 t.	hot water
1/2 c.	nuts
1/2	pkg. semi-sweet choc. bits
1 c.	oatmeal
1/2 t.	vanilla

1. d. One-fourth Recipe

1/4 c.	shortening
3 T.	brown sugar
3 T.	white sugar
1/2	egg
1/4 t.	soda
1/4 t.	salt
6 T.	flour
1/4 t.	hot water
1/4 c.	nuts
1/4	pkg. semi-sweet choc. bits
1/2 c.	oatmeal
1/4 t.	vanilla

2. a. Double Recipe

1 1/2 c.	sifted flour
5 T. or	
1 T 2 t.	baking powder
1 t.	salt
2	eggs
2/3 c.	milk

2. b. Triple Recipe

2 1/4 c.	sifted flour
7 1/2 t. or	
2 T. 1 1/2 t.	baking powder
1 1/2 t.	salt
3	eggs
1 c.	milk

3. a. For Two

1/2 c.	vinegar
1 lb.	beef, chuck
1	bay leave
3	peppercorns
4	cloves
1/8 t.	allspice
1/8 c. or	
2 T.	flour
3/8 t.	salt
1 1/2 T. or	
1 T. 1 1/2 t.	shortening
1 t.	sugar

3. b. For One

1/4 c. or	
4 T.	vinegar
1/2 lb.	beef, chuck
1/2	bay leave
1 1/2	peppercorns
2	cloves
1/16 t.	allspice
3/4 T. or	
2 1/4 t.	shortening
1/2 t.	sugar
1 T.	flour
3/16 t.	salt

Answers to GM-1A (Continued)

4. a. For Twelve

9/4 lb.	liver
9/8 c.	flour
3/2 t.	salt
3/8 t.	pepper
9 T.	shortening

4. b. For Eight

3/2 lb.	liver
3/4 c.	flour
1 t.	salt
1/4 t.	pepper
6 T.	shortening

5. a. One-half Recipe

1/2 lb.	marshmallows
1/2 c.	broken walnuts
3/2 T.	butter
1/2 c.	crisp rice cereal
1/4 t.	salt
1/2 t.	vanilla
4 oz.	semi-sweet choc.

5. b. One-fourth Recipe

1/4 lb.	marshmallows
1/4 c.	broken walnuts
3/4 T.	butter
1/4 c.	crisp rice cereal
1/8 t.	salt
1/4 t.	vanilla
2 oz.	semi-sweet choc.

E. S. E. A. Title III – PROJECT I–C–E 59–70–0135–4

Environmental: **Integrated with:**

CONCEPT NO. 3 - Carrying Capacity **SUBJECT** General Math (Cross Ref: Social Studies)

ORIENTATION Resource Conservation **TOPIC/UNIT** GM-2 Multiplication

BEHAVIORAL OBJECTIVES

Cognitive:

Calculate the demands made on our earth by a single person during his lifetime for given resources, using principles of multiplication, given the appropriate information for a definite time period.

Affective:

Suggest ways to reduce the tendency to waste certain natural resources. Argue that the amount of waste is too high per individual and should be reduced. Advocate the use of garbage for useful purposes, if at all possible in the area.

Skills Used:

1. Multiplication of whole numbers
2. Division of whole numbers

STUDENT–CENTERED LEARNING ACTIVITIES

In-Class:

A. Problems on conservation of natural resources in worksheet GM-2A-1 and GM-2A-2.

B. Our natural resources are not unlimited. Examine and discuss the following projected supplies:
   1. Coal (400 years), natural gas (13 years), oil (30 years), uranium (35 years), electricity (___) as energy sources.
   2. Examine supply of minerals for industrial production: steel (350 years), copper (35 years), tin (30 years), lead (25 years), and zinc (20 years).
   3. Americans are "Super Consumers." They use 50 times as much natural resources as undeveloped nations (i.e. India). Therefore, 6% of the world population uses 30% of its energy.

Outside or Community:

A. Visit a grocery store to find out how much food is sold each week. (per capita)

B. Compare the sales of returnable bottles with non-returnable containers now with those in 1969.

C. Visit community incinerator or sanitary landfill to quantify the refuse discarded each week.

SUGGESTED RESOURCES	CONTINUED OR ADDED LEARNING ACTIVITIES

Publications:

Mishan, E. J., Technology and Growth - The Price We Pay, Praeger, 1969.
Toynbee, Arnold, Change and Habit, Oxford University Press, 1966.
Marine, Gene, America the Raped, Simon and Schuster, 1969.

Audio-Visual:

#7614, Minerals Challenge, color, $2.00, 1970, 30 minutes, BAVI.
#7624, Problems of Conservation: Minerals, color, $6.75, 1969, 16 minutes, BAVI.
#0468, Conservation Road: Story of Our Natural Resources, $3.50, 1947, 20 minutes, BAVI.
Film:
Recycling, color, 21 minutes, #500, I-C-E RMC.

Community:

DNR office
Landfill area
Sanitary system

1. Research has shown that the average individual, during his lifetime, uses the following:

   3,000,000 gallons of water
   20,000 gallons of gasoline and creates
   46 tons of garbage.

   A. Expand this total to a family of six.
   B. Expand this total to the population of a community of 100,000.
   C. Expand this total to the population of a state of 4 million.

2. The garbage output averages 6 pounds per day per person. (This includes all output of garbage from all sources.) How much garbage from all sources will a city of 50,000 put out in a week? How many tons is this? If an incinerator can burn 5 tons per hour, how many hours will it take to dispose of one weeks garbage?

3. At the time of takeoff, a four-engine jet pours out 88 pounds of air pollutants. If such a plane takes off every minute from an airport, how many pounds of pollutants are poured out into the air in 1 hour? In 1 day? In 1 week? In 1 month (30 days)? In 1 year? Convert all of these answers to tons.
4. The office of Economic Research has determined that each pound of municipal solid waste has a heat content of 5,260 B.T.U. Using the figures in Problem "2" find the heat content per day in that city's solid waste as cited in Problem "2."

Answers to GM-2A-1

1. A. 18,000,000 gallons water
120,000 gallons gasoline
276 tons of garbage

B. 300,000,000,000 gallons of water
2,000,000,000 gallons of gasoline
4,600,000 tons of garbage

C. 12,000,000,000,000 gallons of water
80,000,000,000 gallons of gasoline
184,000,000 tons garbage

2. 300,000 pounds
150 tons
30 hours

3.

1 hour 5280 lbs.	2.64 Tons
1 day 126,720 lbs.	63.36 Tons
1 week 887,040 lbs.	443.52 Tons
1 month (30 days) 3,801,600 lbs.	1,900.8 Tons
1 year 46,252,800 lbs. (one day)	23,126.4 Tons
45,619,200 lbs. (12 months)	22,809.6 Tons
46,126,081 lbs. (52 weeks)	23,063.04 Tons

4. 1,578,000,000 B.T.U.

Worksheet GM-2A-2

1. Assuming that the average amount of rubbish disposed of each day by the citizens of Madison is 5 pounds and the population of Madison in 1970 was 171,500, how many pounds of rubbish were thrown away in 1 day? In 1 week? In 1 year? How many tons would this be in 1 year?

2. In his lifetime an average American will personally

   ....pollute three million gallons of water

   ....use 21,000 gallons of leaded gasoline containing boron

   ....drink 28,000 pounds of milk

   ....eat 10,000 pounds of meat

   Using these figures, how much of each of these products would be consumed by a family of five in their lifetimes? By a community of 5,000?

3. If each day a 2 year old steer weighing 700 pounds drinks 12 gallons of water, how many gallons will be required to water 1000 steers in a day?

4. $x = 5n + 14,210,000$ where X represents the U.S. Population in 1970 and n represents the U.S. Population in 1870. If the U.S. Population in 1870 was 38,558,000 what was the U.S. Population in 1970?

5. When the sulfur dioxide content of the air in New York City rises above .2 parts per million, ten to twenty people die as a result. In the five years, 1965 to 1970, sulfur dioxide reached this level once every ten days.

   a. What was the minimum number of people who died in New York City during the five years, 1965 to 1970, as a result of air pollution by sulfur dioxide?

   b. What was the maximum number of people who died in New York City during the five years, 1965 to 1970, as a result of air pollution by sulfur dioxide?

Answers to GM-2A-2

1. One day 857,500 lbs.
   One week 6,002,500 lbs.
   One year 312,130,000 or 156,065 tons (52 weeks)
   319,987,500 or 156,493 tons (365 days)

2.

	Family	Community
Water	15 million gal.	15 billion gal.
Gasoline	105,000 gal.	105 million gal.
Milk	140,000 lb.	140 million lb.
Meat	50,000 lb.	50 million lb.

3. 12,000 gallons

4. 207,000,000

5. a. 1826 b. 3652

E. S. E. A. Title III – PROJECT I–C–E 59–70–0135–4

Environmental:

Integrated with:

CONCEPT NO. 9 - Management

SUBJECT General Math

ORIENTATION Forestry

TOPIC/UNIT GM-3 Arithmetic--Road Map Use

BEHAVIORAL OBJECTIVES

Cognitive:

State the meanings of the symbols on a common road map. Use them in formulating solutions to problems dealing with national forests.

Affective:

Defend the need to preserve and replenish our national forests.

Skills Used:

1. Arithmetic computation
2. Map reading
3. Using scale measure

STUDENT–CENTERED LEARNING ACTIVITIES

In-Class:

A. How many miles does one inch on your map equal? How many square miles in one square inch?
B. What color is used to designate National Forests?
C. List the names of the National Forests in the state of Wisconsin.
D. Locate the one nearest your city. Using the nearest and best highway, find the distance from your home to the forest.
E. Name the one farthest from your city. How many miles is it from your home? Which highway would you follow?
F. In 1933, to relieve the unemployment problem of the U.S., President Franklin Roosevelt organized the Civilian Conservation Corps. for young men. Under this plan, 500,00 men planted trees, built dams and fought fires. One could plant by hand about 700 trees a day. One thousand trees were planted per acre; of these about 100 grow to maturity. (Continued)

Outside or Community:

A. Locate a tree farm near your town. Learn:
   1. When was it planted?
   2. Where were the trees obtained?
   3. How far apart are they planted?
   4. The kind of trees planted.
   5. When the first harvest was made.
   6. The type of region planted to a tree farm.
   7. How tall the trees are today.
   8. Compute their average growth per year.
   9. The approximate age of maturity.
   10. How the government aids in the reforestration program.
B. Have someone from DNR come to the class and speak on the National forests located in Wisconsin.
   1. How many
   2. Total acreage
   3. Use
   4. Future plans

SUGGESTED RESOURCES

Publications:

Wisconsin road maps.
World Book Encyclopedia.
Trees and Forests, Jespen, Stanley Barnes, $6.95, 1969.

Audio-Visual:

Wasted Woods, 15 minutes,
Associated Films
600 Grand Avenue
Ridgefield, N.J. 07657.
Forest Conservation,
Encyclopedia Britannica
425 N. Michigan Avenue
Chicago, Illinois 60611.
Tomorrow's Trees,
#0717, BAVI.
The Forester at Work,
I-C-E RMC.

Community:

Visit a tree farm
Representative from Wisconsin Conservation Dept.

CONTINUED OR ADDED LEARNING ACTIVITIES

CLASSROOM: (Continued)

F. Some of the others were harvested for Christmas trees, posts, poles or pulp. Many acres of the Chequamegan National Forest were planted at this time by the C.C.C. Let us assume that 50% of the 832,480 acres were replanted at this time.
   1. How many acres were planted by the C.C.C.?
   2. Allowing 1,000 seedlings per acre, how many seedlings were planted?
   3. How many trees will reach maturity?
   4. If one man can plant 700 trees in a day, how many days would it take him to plant the trees?
   5. Approximately how old are the trees today?
   6. Two men with a modern machine can plant 10,000 trees in a day. How long would it take a machine to plant the forest?

G. Worksheet GM-3G on road map use.

Worksheet GM-3G

1. Using a Wisconsin road map, find the number of miles you would travel in going from Green Bay to New London, to Clintonville, to Shawano, to Green Bay.

2. Find the number of miles traveled from Green Bay to Sturgeon Bay, to Baileys Harbor, to Sister Bay, to Sturgeon Bay, to Algoma, to Green Bay.

3. If you made a round trip from Green Bay to Madison in five hours, what was your average speed to the nearest mile-per-hour?

4. How is the State Capitol marked on the road map?

5. What does it mean when a city is marked in yellow?

Answers to In-Class A thru F

1. A. 13
   B. Green
   C. Chequamegan
      Nicolet
   D. Nicolet
   E. Chequamegan
      about 160 miles
      Highways 29 and 13

F. 1. 416,240
   2. 416,240,000
   3. 41,624,000
   4. 594,629
   5. Subtract 1933 from the present date
   6. 41,624

Answers to GM-3G

1. 36 + 16 + 15 + 33 = Total of 100 miles

2. 46 + 21 + 9 + 32 + 20 + 36 = Total of 164 miles

3. 53 miles-per-hour

4. 

5. Population of over 10,000

E. S. E. A. Title III – PROJECT I-C-E 59-70-0135-4

Environmental:

Integrated with:

CONCEPT NO. 7 - Land Use

SUBJECT General Math

ORIENTATION Land Use

TOPIC/UNIT GM-4 Percentages

BEHAVIORAL OBJECTIVES

Cognitive:

Compute the cost and time to complete a given stretch of asphalt highway. Determine the acreage and percentage of total of land now covered with road in the county; state, given road acreage per square mile.

Affective:

Weigh the usefulness vs. cost of highways.

Skills Used:

1. Percentage

STUDENT-CENTERED LEARNING ACTIVITIES

In-Class:

Worksheet GM-4A.

A. Problems on Land Use involving percents. Problems 1-7.

B. Problems 8-9.

Outside or Community:

A. Visit a highway work yard or call in a foreman. Ask:
   1. What materials are combined to make asphalt?
   2. What percent of each is used?
   3. How thick is an asphalt highway laid?
   4. What is the life expectancy of an asphalt road?

B. Locate on a world map, the location of the Alaskan Highway, Newfoundland, Texas and the Miami Causeway.

SUGGESTED RESOURCES	CONTINUED OR ADDED LEARNING ACTIVITIES
Publications: EQ Index (soil) National Wildlife Federation 1970 1412 - 16th Street, N.W. Washington, D.C. 20036. **Audio—Visual:** House of Man - Our Changing Environment Encyclopedia Britannica Game: New Highway Game, 5. G. 10 I-C-E RMC. **Community:**	

Worksheet GM-4A

1. Student-centered in-class activity.

   A. The Alaskan Highway from Dawson Creek, British Columbia, to Fairbanks, Alaska, was built in 1942 by U. S. Army engineers. It is 1,500 miles long and 24 feet wide. The cost was $138,000,000. In 1948 the entire road was open for public use.

      1. The highway was built in 75% of a year. How many months was this? How many miles on the average were built per month?
      2. Newfoundland's railway mileage is 50% of the length of the highway. How many miles of railway are there?
      3. About 10% of the highway is in Alaska. What percent is in Canada? How many miles is in Alaska? In Canada?
      4. The distance across Texas is 53% of the length of the Alaskan highway. About how far is it across Texas?
      5. The Miami to Key West Causeway, the longest over-ocean water road is about 83% as wide as the Alaskan Highway. How wide to the nearest foot is the Causeway?
      6. If your car averages 13 miles to a gallon of gas, how many gallons would you use just on the Alaskan Highway?
      7. As the crow flies, how far is it from your home to Fairbanks, Alaska?
      8. There are 3,471,000,000 acres of land in the world which are suitable for cultivation and in North America, there are 566,000,000 acres of land suitable for cultivation. What percent of arable land of the world is in North America?
      9. A 40 acre farm normally produces 2,000 bushels of corn. Through improved procedures, the yield per acre is increased by 25 bushels. What is the percent increase?

Answers to GM-4A

1. 9 months; 167 miles (166 2/3)

2. 750 miles

3. 90%; 150 miles; 1350 miles

4. 795 miles

5. 20 feet

6. 115.5 gallons

7. Check atlas

8. $\frac{566,000,000}{3,471,000,000} \times 100\% = \frac{566}{3,471} \times 100\%$

   $\approx .163 \times 100\% = 16.3\%$

9. 40 acres produces 2000 bushels
   1 acre produces 50 bushels

   an increase of 25 bushels per acre is

   $\frac{25}{50} \times 100\% = 50\%$ increase

E. S. E. A. Title III – PROJECT I–C–E 59–70–0135–4

Environmental:

Integrated with:

CONCEPT NO. 2 - Ecosystem

SUBJECT General Math (Cross Ref: Science-sound)

ORIENTATION Noise Pollution

TOPIC/UNIT GM-5 Percent (Graph)

BEHAVIORAL OBJECTIVES

Cognitive:

Determine and order the number of decibels of sound in six given situations using a decibel meter. Compare, using percentages, the sound intensity of a given noise with the accepted level given a decibel meter to determine the intensity.

Affective:

Promote the idea that noise pollution can cause real physical harm, perhaps as much as air and water, therefore, it should be reduced. Select a lower level of volume of music, etc., for listening if given a choice. Take proper precautions to protect himself from excessive noise levels upon his own volition.

Skills Used:

1. Use of decibel meter
2. Percent
3. Bar graphing

STUDENT–CENTERED LEARNING ACTIVITIES

In-Class:

A. Problems on graphing and percent using decibel meter.
Worksheet GM-5A.

Outside or Community:

A. Students will take a poll of parents and neighbors: Would you be willing to pay
   1. $310 for an air conditioner which makes less noise than one for $288?
   2. $99 for a quieter vacuum compared to $90?
   3. $1.25 more for a less noisy hair dryer?
   4. $10 more for a quieter lawn mower?
   5. Higher taxes so the city could purchase less noisy garbage trucks?

Item	Yes	%
	No	%
	Undecided	%

B. Report to the class on the results of an interview with someone.

SUGGESTED RESOURCES	CONTINUED OR ADDED LEARNING ACTIVITIES

Publications:

Readers Digest, Feb., 1970,
We're Poisoning Ourselves With Noise.
Pollution, Wisconsin Dept. of
Public Instruction.
Saturday Review, May 27, 1967,
Noise Pollution.

Audio—Visual:

Noise, The New Pollutant,
Indiana U. AV Center
Bloomington, Indiana 47401.
Film: Your Ears, BAVI,
#0609, color, 6 minutes.
Film: Death Be Not Loud,
#490, color, 26 minutes, I-C-E RMC.

Community:

Visit to local "noisy" industries
E.G. National Can Corp.,
Green Bay, Wisconsin

Worksheet GM-5A

1. After a short class discussion on the meaning of decibel, and use of a decibel meter, what sounds are annoying, and how such noises affect people physically, the class will then draw a bar graph of the following:

   a. Classroom during small group discussion
   b. Corridors between classes
   c. Corridors during class
   d. Gym class
   e. Record "sock hop"

2. Students will make a bar graph to show the number of decibels of each of the following:

Jet plane on take-off	130	Power mower	107
Deck of a carrier	140	Riveting	130
Outboard motor	102	Vacuum cleaner	81
Snowmobile	118	Kitchen blender	93
N.Y. Subway station	100	Motor bike	110
Freeway traffic	89	Electric guitar with rock music	114

3. For each of the following, find the percent above the safe level, to the nearest tenth of a percent. (The safe level is 85 decibels.)

   a. Jet plane on take-off
   b. Deck of a carrier
   c. Snowmobile
   d. N.Y. Subway station
   e. Motor bike

4. A garbage truck can be built with sound deadening equipment to the "tune" of about $100 a truck. If a city were to buy 20 such trucks, how much would this cost? If there were 40,000 taxpayers in that city, find the cost per taxpayer.

5. Loudness of sounds is measured in decibels. According to scientists, sounds above 85 decibels can eventually damage the human ear. A motorbike vroom may reach 110 decibels. This is how many decibels higher than the safe level of 85 decibels? This increase of sound is what percent above the safe level? (to the nearest tenth)

Answers to GM-5A

1. Graph

2. Graph

3. a. 52.9%
   b. 64.5%
   c. 38.8%
   d. 17.6%
   e. 29.4%

4. $2000 $.05 per taxpayer

5. 25 decibels 29.4%

E. S. E. A. Title III – PROJECT I-C-E 59-70-0135-4

Environmental:

Integrated with:

CONCEPT NO. 8 - Values and Attitudes

SUBJECT General Math

ORIENTATION Environmental Economics

TOPIC/UNIT GM-6 Percent - Area

BEHAVIORAL OBJECTIVES

Cognitive:

Compute the percent of space; time used in magazines, newspapers and television for advertising purposes.

Affective:

Promote the power of advertising in influencing the general population toward conserving the environment. Investigate the percentage of advertising space in the local paper(s) that is devoted to maintaining or improving the environment.

Skills Used:

1. Percent
2. Area of rectangle

STUDENT–CENTERED LEARNING ACTIVITIES

In-Class:

A. Class divides into small groups to discuss these questions:
   1. What is your reaction to TV commercials?
   2. What is the main purpose of TV and radio ads?
   3. In your local newspaper, what night is there the most advertising? Is there a reason for this?
   4. In what ways do numbers play an important part in ads and commercials?
   5. As a result of listening to commercials, do you buy their products? Do your parents?
   6. What percent of the space in newspapers and magazines is for advertising?
   7. Does advertising have an effect on our environment?

B. Worksheet on Areas and Percentages, GM-6B.

Outside or Community:

A. Watch a TV commercial critically.
   1. Count the number of times the product is mentioned.
   2. Is there anything about the product that is detrimental to our environment?

B. Survey the members of your family.
   1. What new products have you bought lately?
   2. How did you hear about this product?

C. Analyze a magazine ad.
   1. What does it claim?
   2. Are these claims just?

D. Prepare a bulletin board display of newspaper and magazine ads which include percents.

SUGGESTED RESOURCES	CONTINUED OR ADDED LEARNING ACTIVITIES
Publications: Magazines Newspapers **Audio–Visual:** Radio TV Film: Noisy Landscape, color, 14 minutes, #170 I-C-E RMC. Film: 1985, color, 56 minutes, #520, I-C-E RMC. **Community:**	

Worksheet GM-6B

1. A page of a magazine measures 15" long and 10" wide. An advertisement is 3" wide and 5" long. The advertisement is what percent of the page?

2. During a television show of 1 1/2 hours, 15 minutes are devoted to commercials. What percent of the total program is given over to commercial messages?

3. A sponsor agreed to finance a TV show providing that at least 10% of the time period was alloted to commercials. If the program ran for 1/2 hour, what is the minimum number of minutes the sponsor is asking for?

4. Select one issue of a magazine or daily paper and find what percent of it is used for advertising.

5. Using a stop watch during an hour of TV watching, tabulate the amount of time used for commercials.

Answers to GM-6B

I. A. Note to teacher: Emphasize the point that commercials affect attitudes and trends in the listener.

1. 10%

2. 16 2/3%

3. 3 minutes

E. S. E. A. Title III – PROJECT I–C–E 59–70–0135–4

Environmental:

Integrated with:

CONCEPT NO. 6 - Resources

SUBJECT General Math (Cross Ref: Biology)

ORIENTATION Wise Use of Resources
Local Community

TOPIC/UNIT GM-7 Percents (story problems)

BEHAVIORAL OBJECTIVES

Cognitive:

Calculate percentages of each flora species in a given area of marshes. Calculate percentages of the sizes (diameters, height, etc.) of given flora species.

Affective:

Promote the preservation of the wetlands for wildlife and its resources.

Skills Used:

1. Story problem solving
2. Percentage
3. Basic computation

STUDENT–CENTERED LEARNING ACTIVITIES

In-Class:

A. Problems on land and forest use on Worksheet GM-7A.

Outside or Community:

A. Field trip to a wetland area.
   1. How large of an area is the marsh?
   2. How many different species of flora can the student find and identify?
   3. What is the average size of the different trees? (Students will have to know the different ways of measuring a tree.)
   4. Is there a pond in the forest? What factors control the pond? What is its total area? Widest distance across the pond?

SUGGESTED RESOURCES	CONTINUED OR ADDED LEARNING ACTIVITIES

Publications:

Making Peace with the Marshes of New Jersey, Smithsonian, Mar., 1972.
Life of the Marsh, William A. Niering, McGraw-Hill.
Vegetation of Wisconsin, J. T. Curtis, U. of Wisconsin, 1959.
Freshwater Marshes, National Audubon Society, 1130 Fifth Avenue, New York, N.Y. 10028. (Available in quantities of 35 or more at 20 cents each.)

Audio-Visual:

Film:
Cry of the Marsh, #7350, BAVI.
Marsh Waters - Waste or Wealth, #0445, BAVI.
World in a Marsh, McGraw-Hill.
One Day at Teton Marsh, #200, I-C-E RMC.
Filmstrip:
Cherokee Marsh - A Wetland to Cherish, Instructional Material Center, Madison, Wisconsin.

Community:

DNR
Flood plains
Library
County Conservation Agency
Wetlands for Wildlife
5 Charles Backes
11258 N. Revere Rd.
Mequon, Wisconsin 53092
Horicon marsh area

Worksheet GM-7A

1. Problems on marshes. In New Jersey, there are 400,000-500,000 acres of marshland in the state with 10% of the wetlands having already been destroyed. In recent years in Hackensach Meadows alone, the marsh is being filled in at the rate of 30,000 tons a week. Each acre of the meadows is valued at $70,000 for landfill.

   a. Using the information given, New Jersey previously had how many acres of marshland?
   b. If the Hackensach Meadows was made up of 20,342 acres, how much would the meadows be worth for landfill purposes?
   c. What does the given information tell you about the importance of wetlands?

2. Dane County, Wisconsin.

   a. Dane County is a shrinking wetland area. A survey completed in 1958 indicates the loss of 22,677 acres of wetland to drainage during a 20-year period (an average equivalent to nearly 140 Wisconsin farms). This loss represents 1/3 of the wetlands that were inventoried in 1938. Indications are that the trend will continue.
   b. The surface waters and wetlands are used for hunting. In 1960, over 16,200 persons bought small game hunting licenses in Dane County. National surveys estimate that nearly 1/5 of this number hunt waterfowl, therefore, receiving direct benefits from open water and wetland areas. Moreover, marshlands provide optimum habitat for upland game birds and small game animals, therefore, benefiting nearly all hunters.
   c. Questions:
      1. How many wetlands were inventoried in 1938?
      2. If the present trend continues, how many acres will be lost by 1978? This is approximately how many farms?
      3. How many persons hunted waterfowl in 1960?

3. Northern Forest - Lowlands.

   The lowlands take up 2,241,400 acres or 6.40% of the land surface of Wisconsin. The lowland forest has 27 tree species, mainly black spruce, tamarack, white cedar, balsam fir, jack pine, hemlock, yellow birch, black ash, and American elm. The prevalent groundlayer has approximately 193 species of flora. (The most important factor of a northern lowland forest is the organic or peaty substrate.)

   a. How much total land surface does Wisconsin have?
   b. If each species of tree had an equal amount of land, how many acres would each specie require?
   c. Discuss the use of the marshland in the area.

Answers to GM-/A

1. a. 444,444 to 555,555
   b. $1,423,940,000
   c. Answer will vary

2. a. 68,031 acres
   b. 22,677 acres - 140 farms
   c. 3,220 people

3. a. 34,892,500 acres
   b. 83,615 acres
   c. Answer will vary

E. S. E. A. Title III – PROJECT I–C–E 59–70–0135–4

Environmental: **Integrated with:**

CONCEPT NO. 11 - Individual Acts **SUBJECT** General Math

ORIENTATION Mass Transportation **TOPIC/UNIT** GM-8 Percent

BEHAVIORAL OBJECTIVES

Cognitive:

Compare the advantages and disadvantages of each type of mass transportation. Determine which method will save natural resources, yet, be convenient.

Affective:

Promote the idea that we must sacrifice some conveniences to save our own environment. Use mass transportation whenever feasible as a way of reducing pollution.

Skills Used:

1. Percents
2. Problem analysis

STUDENT–CENTERED LEARNING ACTIVITIES

In-Class:

A. Worksheet GM-8A on transportation problems involving percents.

Outside or Community:

A. Survey the number of empty seats in cars while traveling along a highway.
   1. The student will have to judge the carrying capacity of each car.
   2. After judging the capacity, how many empty seats were in each car?
   3. Total #1 and #2 and tabulate the results.
   4. Project this to a national average.

B. Conduct a litter count.
   1. Determine cost of man hours to restore the area to its original condition.
   2. Extend this cost to the area of your city or state on an annual basis.

SUGGESTED RESOURCES	CONTINUED OR ADDED LEARNING ACTIVITIES
Publications: Don't Use Traffic Jam or Peanut Butter Sandwiches, I-C-E RMC. **Audio–Visual:** New Highway Game, SG 10, I-C-E RMC. KT 13 America's Urban Crisis, I-C-E RMC. Film: Boomsville, color, 10 minutes, #400, I-C-E RMC. **Community:** County Highway Dept. Local Police Dept. Local Transit Auth.	

Worksheet GM-8A

Use these facts to solve the following problems:
1. Cars amount for 67% of traffic but carry only 15% of passengers.
2. One passenger train can carry traffic equal to 20 traffic express lanes.
3. Population of 1,000,000 people travel 5,000,000 miles per day.

---

1. How many miles are traveled daily by automobile?

2. How many people travel by automobile daily if the entire population travels daily?

3. How many people travel by a mode of transportation other than automobile?

4. Six passenger trains can free how many traffic express lanes?

5. Make up two problems concerning mass transportation and submit them to your teacher. Be sure to show the solution to problems.

6. The Aswan Dam project built on the Upper Nile River stopped the flow of nutrient-rich silt from reaching the Mediterranean Sea. Without this silt, the Egyptian sardine catch declined from 18,000 tons in 1965 to 500 tons in 1968. What percent of the 1965 catch was reaped in 1968? (to the nearest tenth of a percent)

7. The birth rate is the number of births per thousand per year.

$$\text{birth rate} = \frac{\text{Total number of births per year}}{\text{total population}} \times 1000$$

Rate of natural increase = birth rate - death rate
Using the information above, complete the table.

Community	Population	Births	Deaths	Birth Rate	Death Rate	Nat. Inc.	% Inc.
Madison	171,500	3115	1059				
Wausau	31,675	562	316				
Green Bay	81,120	1510	645				
Your Community							

8. In Central America, the birth rate is 45 per thousand but the death rate is 11 per thousand.
   a. State the birth rate as a percent.
   b. What is the rate of natural increase?
   c. What is the percent of increase?
   d. At a birth rate of 45 per thousand, how many births would there be out of 238,000 people?

Worksheet GM-8A (Continued)

9. By mid-1970, we had about 3.6 billion people in the world.

   a. At an annual growth rate of 1.9% what would be the population by mid-1971? By mid-1972?

10. The population of South America in 1965 was 240,000,000. It is predicted to be 624,000,000 by the year 2000.

    a. What would the amount of increase be?

    b. What would the percent of increase be?

11. Give your opinion as to what effect the rate of population increase will have on modes of transportation.

Answers to GM-8A

1. 5,000,000 miles

2. 670,000 people

3. 330,000 people

4. 120,000 lanes

5. a.

   b.

6. 2.8%

7.

Community	Birth Rate	Death Rate	Nat. Inc.	% Increase
Madison	18 per 1000	6 per 1000	12 per 1000	1.2%
Wausau	18 per 1000	10 per 1000	8 per 1000	.8%
Green Bay	19 per 1000	8 per 1000	11 per 1000	1.1%

8. a. 4.5%
   b. 34 per 1000
   c. 3.4%
   d. 10,710 births

9. a. 3.6684 billion or 3,668,400,000
      3.7365 billion or 3,736,500,000

10. a. 384,000,000
    b. 160%

11. Answers will vary.

E. S. E. A. Title III — PROJECT I-C-E 59-70-0135-4

Environmental:

Integrated with:

CONCEPT NO. 10 - Economic Planning

SUBJECT General Math

ORIENTATION Cost of Environmental Control

TOPIC/UNIT GM-9 Percent and Arithmetic Computation

BEHAVIORAL OBJECTIVES

Cognitive:

Solve the problems related to the cost of environmental controls using the principles of percentage computation.

Affective:

Investigate the values and priorities in seeking an answer to the question: "Can we afford environmental control?"

Skills Used:

1. Problem solving
2. Percents
3. Arithmetic computation

STUDENT-CENTERED LEARNING ACTIVITIES

In-Class:

Note: Teacher should examine the many options listed under the activities of Concept 10.

A. Class Discussion.
   1. Are people in our community, state and nation aware of environmental problems?
   2. If so, what are they doing as individuals to help?
   3. Are citizens demanding that their local, state and federal governments initiate projects to benefit our environment?
   4. Are we willing to pay higher taxes for such projects?
   5. How does spending in this area compare with money we spend for recreation and luxuries?

B. Have students complete the worksheet, Where Does All the Money Go? Worksheet GM-9B.

C. Worksheet GM-9C.

Outside or Community:

A. Research Projects:
   1. From the water plant in your community, find the annual cost of keeping drinking water safe. Find the approximate cost per family and per person.
   2. Dirty air is costly to the American people. Because of it they spend $6.1 billion in health costs and $5.2 billion in costs to their residences. How much is this per family and per person?
   3. Today's technology can provide ways of reusing metals, converting waste into usable products. Make a poster to illustrate some of the specific ways this can be done.

B. Have leaders from local industries report on what their industries are doing in regard to cleaning up the environment: cost, length of time to fulfill the program.

(Continued)

SUGGESTED RESOURCES	CONTINUED OR ADDED LEARNING ACTIVITIES

Publications:

Pollution, Wis. Dept. of Public Instruction.
VF Scientists Institute for Public Information,
Environmental Cost of Electric Power, I-C-E RMC.

Audio-Visual:

All of the People All of the Time, #3345, BAVI.
3rd Pollution, #6928, BAVI.
Every Drop Fit to Drink, #6141, BAVI.
Film: The Stream, color, 15 minutes, #320 I-C-E RMC.

Community:

Leaders from local industry.
City director of public works.

OUTSIDE: (Continued)

C. Also city director of Public Works will give a talk to the students on how much the city pays to help clean up the environment.

Continued and Additional Suggested Learning Experiences

Numbers in the News

Subject: Where Does All The Money Go?

"Where does all the money go?" has been asked by people since the creation of money as an economic use. To help us understand where the money goes, we are often told that we must "budget." A budget is a plan for spending and saving so that we are not surprised by lack of money. Frequently, experts prepare budget guidelines so that budget planners will have some knowledge of how to plan for their particular needs.

The table that follows is a budget guideline prepared recently by the American Bankers Association.

Monthly Take-Home	Family Size	Savings	Food	Housing	Clothing	Transportation	Personal, etc.
$315	2	$ 7	$ 84	$ 95	$ 23	$ 39	$ 67
	4	5	100	95	34	35	45
425	2	15	105	125	35	55	90
	4	10	125	130	45	50	65
525	2	25	125	160	45	70	100
	4	20	140	165	65	65	70
650	2	45	140	190	65	85	125
	4	40	155	200	75	80	100
850	2	80	175	225	85	115	170
	4	55	195	250	95	115	140
1050	2	130	210	250	100	150	210
	4	100	230	270	110	150	190

Which income and family size is expected to save:

A. $1200 per year - Income of_____family size of_____.
B. 960 per year - Income of_____family size of_____.
C. 120 per year - Income of_____family size of_____.
D. 480 per year - Income of_____family size of_____.

How much more does a family of 4 with a monthly income of $650 per month spend on housing than on food per month?_____per year?_____ How much more on housing than on clothing per month?_____per year?_____ If a family of 4 increases its income as follows, how many "times is it expected to increase its savings?"

A. From $315 to $ 425_____ B. From $315 to $525 _____ C. From $315 to $650_____
D. From $315 to $1050_____ E. From $425 to $850_____ F. From $525 to $1050_____

The bar below represents a $650 monthly income for a family of 4. Each section of the bar represents the suggested amount of money to be budgeted for the items listed in the chart above. Label each section of the bar. We have labeled one section for you.

Answers to GM-9B

1. A. $1050 per month family size 4
   B. $ 850 per month family size 2
   C. $ 425 per month family size 4
   D. $ 650 per month family size 4

2. $45 month $540 per year $125 per month $1500 per year

3. A. 2 B. 4 C. 8
   D. 20 E. 5.5 F. 5

4.

A. Housing	B. Trans.	C. Food	D. Clothing	E. Personal	F. Saving

Worksheet GM-9C

Solve the following problems from Pollution.

1. The following figures are an estimate of what it would cost to accomplish an "acceptable" clean-up over a 5-year period: water, $26-$29 billion yearly; air in metropolitan areas, $12-$15 billion yearly; and solid waste disposal, $15 billion yearly.

   a. What would such a program cost for 5 years using the minimum figures? The maximum figures?

   b. If our population in those 5 years averaged 210,000,000, what would be the cost per each man, woman and child for this clean-up, based upon the minimum figures? The maximum figures?

2. For the fiscal year 1968, the U. S. Congress appropriated $200 million for clean-water measures, compared with the $450 million authorized in 1965. Why do you think the appropriation was decreased?

3. One study reveals that 95 million Americans drink water not meeting federal standards or of unknown quality. What % of the U. S. population (202,000,000) is drinking water that fits these conditions?

4. In 1966, Americans spent $25 billion of our nations wealth for packaging. Of this amount we literally threw away $14.6 billion because of our inability or indifference to recycling. This is what % of the total amount spent on packaging in 1966? How could we get people to become more aware of the advantages of recycling?

Answers to GM-9C

1. a. $53,000,000,000 minimum
   $59,000,000,000 maximum

   b. $252.38 minimum
   $280.95 maximum

2. Answers vary

3. 47%

4. 58.4%

E. S. E. A. Title III - PROJECT I-C-E 59-70-0135-4

Environmental:

Integrated with:

CONCEPT NO. 11 - Individual Acts

SUBJECT General Math

ORIENTATION Community Problems

TOPIC/UNIT GM-10 Recreational Math

BEHAVIORAL OBJECTIVES

Cognitive:

Calculate the answers to a given set of word problems using the principles of addition, subtraction, multiplication, division and percentages and check by correctly fitting the answers into a cross number puzzle. Define the terms commonly used in discussions on environment.

Affective:

Promote the idea that there are many facets to the environmental problems of today. Promote the idea that alternatives must be evaluated when suggested solutions to environmental problems.

Skills Used:

1. General arithmetic
2. Cross-number puzzle solving

STUDENT-CENTERED LEARNING ACTIVITIES

In-Class:

A. Class Discussion:
   1. As you read magazine and newspaper articles, what environmental problems seem to be most acute in your community now?
   2. What are some important terms used in articles about environmental quality?

B. Worksheet GM-10B - Puzzle on environmental terms.

C. Worksheet GM-10C - Environmental Cross-number Puzzle.

D. Worksheet GM-10D - Math and Ecological Word Puzzle.

E. As a mental exercise, try Worksheet GM-10E on Brain Teasers.

Outside or Community:

A. Collect newspapers and magazine articles about your local environmental problems.

B. In your school, family or some club to which you belong, initiate some project which will improve the quality of our environment. (collect paper, cans, etc.)

C. Interview a member of the city council or town board concerning local problems of pollution of air or water.

SUGGESTED RESOURCES	CONTINUED OR ADDED LEARNING ACTIVITIES
Publications: Current newspapers and magazines. U.S. News and World Report, March 20, 1972, Can U.S. Win the War Against Pollution? **Audio–Visual:** Vanishing Air, Ralph Nader's Study Group, Grossman Pub., 1970. Air Pollution Primer, National Tuberculosis and Respiratory Disease Assoc., N.Y. Film: Men at Bay, color, 25 minutes, #250, I-C-E RMC. **Community:** City council member. Town board member.	

Worksheet GM-10B

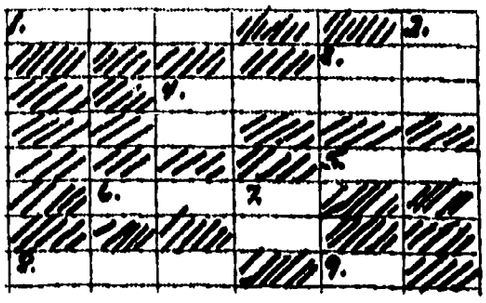
H	A	B	H	F	O	R	E	S	T	M	T
C	D	A	S	G	R	A	N	W	A	C	D
R	L	I	O	S	U	R	V	I	V	E	F
A	R	S	L	T	I	R	I	L	O	O	G
E	B	A	I	R	C	E	R	D	P	L	F
S	O	X	D	N	E	C	O	L	O	G	Y
E	R	A	W	A	M	Y	N	I	L	W	R
R	T	V	A	D	L	C	M	F	L	G	Y
C	R	I	S	I	S	L	E	E	U	Z	I
A	B	A	T	E	M	E	N	T	T	K	J
P	O	R	E	B	M	I	T	A	E	H	S

Puzzle No. 1

Circle these words in the puzzle:
survive, wildlife, ecology,
environment, abatement, forest,
solid waste, recycle, crisis,
soil, air, pollute, aware,
research, timber, ice

Worksheet GM-10C

Puzzle No. 2



Across:

1. The minimum standard for sulphur oxide is 80 microgram per cubic meter. In 1969 Chicago was 184. How much did it exceed the minimum?
3. A family of ten averages 4.1 pounds of garbage per person per day. List the amount of garbage produced by this family in an average day.
4. A paper drive had 4 centers and collected 5240, 8760, and 4960 lbs. at 3 of these. How much must they collect at the 4th to make an average of 5860 lbs. per center that day?
5. Fox Cities industries spent at least $2.8 million on pollution abatement equipment in 1971 and plan to spend at least $7.2 million in 1972. Find the increase in millions.
6. Find the % increase (nearest %).
8. In 1975 the cost of cleaner environment will be $28.9 billion. This is 130% increase over 1970. Find the cost in 1970, (nearest tenth of a billion).
9. In 1971 the federal government gave cities $1.2 billion to build or modernize 1300 waste treatment facilities. Find the average amount of each (nearest tenth of a million).

Down:

2. Each American throws away about 5 lbs. of rubbish daily. How many lbs. is this per week for a family of 6?
3. If 11,664 acres of land were cleared to make a highway 243 miles long, how many acres is that for each mile?
4. If loss of water is 1/2 cu. ft. in 5 minutes, in an hour how many gallons will be wasted? (7 1/2 gal. = 1 cu. ft.)
7. The "Trash Center" had a special drive for glass bottles. They collected 762. What % of 1000 had they collected (to the nearest %)?

Answers to GM-10C

Across		Down	
1.	104	2.	210
4.	4480	3.	48
5.	44	4.	45
6.	157	7.	76
8.	22.2		
9.	9		

Worksheet GM-10D

Encircle all mathematical and ecological symbols or words. Words may be horizontal, vertical, or diagonal. Some words may be in reverse order. See if you can identify 50 words or more, other than those marked as examples.

Worksheet GM-10E

Brain Teasers

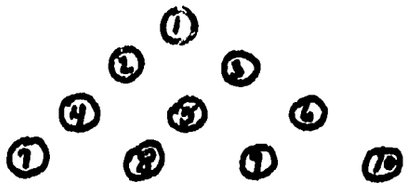
Allow yourself no more than four minutes to come up with the solution to each of the following brain teasers. When you become completely frustrated, you can find the answers from your teacher (maybe).

1. POP-OFF

   Place a dollar bill flat on a table. Turn an empty pop bottle upside down so that its mouth rests on the center of the bill. Without tipping over the bottle, and allowing nothing to touch the bottle other than the bill or the table, remove the dollar bill from beneath the bottle.

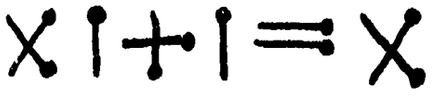
2. TURN ABOUT IS FAIR PLAY

   A triangle of ten pennies points away from you. Moving only three pennies, make the triangle point toward you.



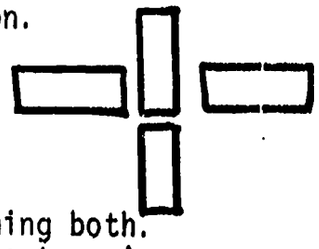
3. WRONG OR RIGHT

   Arrange ten matches so that they create the equation in Roman numbers: XI + I = X. This equation is incorrect. Make the equation read correctly without touching anything.



4. SQUARES

   Place four identical rectangular cards in this position. Now form a square by moving only one card.

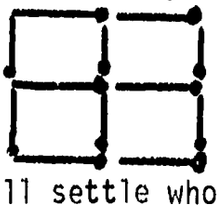


5. SWITCH

   Set a nickel between two quarters with its edges touching both. Now get the right-hand quarter into the middle position--without moving the nickel or touching the left-hand quarter.

6. TWO FROM FOUR

   Twelve sticks are placed on the table to form four squares. Remove two matches and leave only two squares.



7. TIP-OFF

   "Here's how we'll settle who tips the waiter," says your friend at lunch. He tears one paper match out of a matchfolder. "I'll toss it. If it lands on either side, I'll pay. If it stands on edge, you pay." Should you agree? Why or why not?

Answers to GM-10E

Brain Teasers

1. Using the thumb and index finger of each hand, carefully roll up the dollar bill from one end, permitting the roll to push the bottle slowly off the bill.

2. Move 7 to the left of 2; 10 to the right of 3; then 1 below and between 8 and 9.

3. Run around to the other side of the table and look.

4. Move the top card upward until the opened space forms a square.

5. With the left index finger, press firmly on the nickel. With two right-hand fingers, slide the right-hand quarter to the right, then strike it firmly against the nickel. The left-hand quarter will spring aside. Move the right-hand quarter into the exposed space.

6. Remove any two inside matches that meet at a right angle. This leaves two squares, a small one inside a big one.

7. Don't. Just before tossing, he'll bend the match between thumb and forefinger.

E. S. E. A. Title III – PROJECT I–C–E 59–70–0135–4

Environmental: | **Integrated with:**

CONCEPT NO. 12 - Stewardship | **SUBJECT** General Math

ORIENTATION Soil Conservation | **TOPIC/UNIT** GM-11 Problem Solving

BEHAVIORAL OBJECTIVES

Cognitive:

Develop two math word problems on soil conservation, as a result of observation and data about amounts, to be solved by the class.

Affective:

Accept responsibility of using our land resources wisely to provide for the future. Compliment efforts of the U.S. Soil Conservation Office to maintain and upgrade this resource.

Skills Used:

1. Problem solving

STUDENT–CENTERED LEARNING ACTIVITIES

In-Class:

A. The U. S. soil resources are the envy of the world because as a nation, we are blessed with good soil and because we have had a Soil Conservation Program. However, we cannot be complacent.
Class Discussion.
   1. Bulldozers are eliminating about a million acres of land a year. For what purposes are these acres being taken? (highways, urban developments, airports, parks, etc.)
   2. How can we take better care of our land?
      a. Prevent erosion
      b. Forest management
      c. Better care of pasture-land and crops
   3. Crops from 25% of our acres are exported. How can we utilize our land better so we can assume a greater role in feeding the hungry nations of the world?

B. Worksheet GM-11B on Soil Use.

Outside or Community:

A. Students can interview parents or friends about soil conservation.
B. Each group of 3 or 4 students will choose an area of our state, and list the state parks (and their area) in that area.
C. Field trip to a state forest or state park.

SUGGESTED RESOURCES	CONTINUED OR ADDED LEARNING ACTIVITIES
Publications: World Almanac Map of Wisconsin **Audio–Visual:** Our Vanishing Land, color, 24 minutes, McGraw-Hill, 330 West 42nd Street N.Y., N.Y. 10018. Bulldozed America, 25 minutes, Carousel Film, Inc. 1501 Broadway N.Y., N.Y. 10035. Film: Cry of the Marsh, color, 12 minutes, I-C-E RMC. **Community:** County Agent	

Worksheet GM-11B

1. United States has 636 million acres of land suitable for cropland. We are only using 60% of this. To the nearest acre, how many acres are being farmed?

2. If 300,000 acres are lost annually to misuse of the soil, and we have 636 million acres of cropland, how long will it take (nearest year) to waste all of the land.?

3. If the city of Green Bay uses 2 acres a day for their sanitary landfill, how much land will be lost for this purpose in the next 10 years?

4. If Wisconsin has 20,000,000 acres of lowland and marshland, and 10% of this is lost to wildlife each year, find how much is lost.

5. Each year one million acres of land are converted from Agricultural use to urban uses. This would be how many acres per day?

6. If Farmer Jones has a 200 acre farm and he loses 1/4 of an acre a month to soil erosion, how many acres a year is this? What percent of his farm would he lose in 10 years?

7. An acre of topsoil 7" deep weighs 1000 tons. When land is planted with wheat, 10 tons of soil are lost per acre, and with corn 40 tons per acre. What % is lost with each?

Answers to GM-11B

1. 381,600,000 acres

2. 2120 years

3. 7300 acres

4. 2,000,000 acres

5. 2740 acres

6. 3 acres 15%

7. 1% 4%

E. S. E. A. Title III – PROJECT I–C–E 59–70–0135–4

Environmental:

CONCEPT NO. 4 - Water

ORIENTATION Water Supply

Integrated with:

SUBJECT General Math

TOPIC/UNIT GM-12 Problem Solving and Meter Reading

BEHAVIORAL OBJECTIVES

Cognitive:

Calculate the amount of water used per person/per day from data which includes the amounts of water used in each activity of a person.

Affective:

Believe in the value of water as a natural resource. Form judgments as to the responsibility of individuals, industry and the community in maintaining a clean water supply. Weigh alternative to the present one water main distribution system whereby water for all uses must have the same standards.

Skills Used:

1. Meter reading
2. Data collecting
3. Problem solving
4. Volume of rectangular solid

STUDENT–CENTERED LEARNING ACTIVITIES

In-Class:

A. Worksheet GM-12A on usage of water.

Outside or Community:

A. Civic
   1. Read water meter in home daily.
   2. Visit a water treatment plant.
   3. Find out which cities and towns contribute pollution to local waters.
   4. Check to see if each city provides adequate waste treatment.
   5. Do existing facilities measure up to present pollution loads?
   6. From data gathered, figure out cost of cleaning polluted water.
   7. Does local plant operate 24 hours a day? 365 days a year?
   8. If plant claims 90% efficiency, how many times a year is that percentage reached?

B. Industry
   1. If treatment is inadequate, what steps is industry taking to increase its facilities?

(Continued)

SUGGESTED RESOURCES

Publications:

National Council for Air and Stream Improvement, 103 Park Avenue, N.Y., N. Y. 10026.
American Public Health Assn. 1704 Broadway, N.Y., N. Y. 10019.
American Institute of Plant Engineers Industrial Pollution Committee, 1056 Delta Avenue Cincinnati, Ohio 45208.
Water Pollution Control Federation 3900 Wisconsin Avenue, N.W. Washington, D.C. 20016.

(Continued)

Audio-Visual:

Garbage, Film 260, King Screen Prod., 10 minutes.
Film: The 1st Pollution, color, 26 minutes, #450, I-C-E RMC.

Community:

Kimberly Clark: Publications and pamphlets available at main office.
The New River, 16 mm. sound color film available from Public Relations Dept., Neenah.

CONTINUED OR ADDED LEARNING ACTIVITIES

OUTSIDE: (Continued)

B. 2. What will be the cost to improve facilities? Who will be paying the added cost?
C. Write to the "Federal Water Pollution Control Administration"*** for guidelines of pollution control.
D. Check your local industries and city water supply to see if they compare favorably.
E. Begin family campaigns to minimize water consumption:
   1. Check ball float on lavatory
   2. Dripping faucet should be checked and fixed if faulty.
   3. Keep cold drinking water in refrigerator.
   4. Avoid running tap water unnecessarily.
   5. Use saver on washing machine.
   6. Have students find other ways to save water.
F. Evaluate the inconvenience of water saving.
G. Compare consumption of water in U.S. with consumption in the other countries.
H. Find out where the water from down spouts and drain tiles go. If they are hooked up to the municipal sewer, an ordinary rainy day will increase the flow in the sewer line from your house by 300% or more.
I. Outside worksheet GM-12I.

*** 3900 Wisconsin Avenue, Washington, D.C.

PUBLICATIONS: (Continued)

Water in Industry - A Survey of Water Use in Industry, National Association of Manufacturers and Chamber of Commerce of U.S., $2.00, January, 1965.
Clean Water - It's Up To You, free booklet, Izaak Walton League of America 1326 Waukegan Road, Glenview, Illinois 60025.

Worksheet GM-12A

1. An imaginary lake is 400 feet wide, 15 feet deep, and 10,000 feet long. If there are 7.48 gallons of water per cubic foot, how many gallons of water are in the lake?

2. How long would it take to consume all the lakes water---given the town's population of 100,000 and the daily personal consumption rate of 60 gallons per person?

3. Examine the water needs of man (150 gallons per person), broken down as follows:

   60 gal. personal use
   20 gal. commercial use
   10 gal. distribution losses
   50 gal. industrial uses
   10 gal. livestock

   Using the figure of 150 gallons per day per person, how much water is used by a family of 5 per day; per week; per month, (30 days), per year; in 10 years?

4. Each student will determine the amount of water used by his family by reading the water meter each morning in his home.
   a. Each student will keep a daily record of water used by his family.
   b. Compare this with the established norm of 60 gallons per person/ per day.

Answers to GM-12A

1. 448,800,000 gallons

2. 74.8 days

3.

750	gallons per day
5,250	gallons per week
22,500	gallons per month of 30 days
273,750	gallons per year
2,737,500	gallons per 10 years

4. Optional problem.

Outside Worksheet GM-12I

If you are in the habit of letting the water run when you brush your teeth, try this plan. The next 5-10 times you brush your teeth, put a container under the faucet and catch the water that would have run down the drain. Measure the amount and arrive at the average number of pints, quarts, or gallons that would have gone down the drain. If you brush your teeth on the average of three times a day, how much water would you use in one day? If there are four members in a family, what would such a family waste in one day? One week? One year?

If you limited yourself to using just one cup (standard measuring cup) of water to brush your teeth what fractional part would this be of the water that you used when letting the water run? Can you express this savings as a percent?

There are 7 1/2 gallons of water in a cubic foot. How many cubic feet of water would the family of four have used in the year? Find the cost of a cubic foot of water in the community in which you attend school. Find the cost of the water used then by a family of four in your community.

E. S. E. A. Title III – PROJECT I-C-E 59-70-0135-4

Environmental: **Integrated with:**

CONCEPT NO. 4 - Water **SUBJECT** General Math (Cross Ref-Science - Biology)

ORIENTATION Water Supply **TOPIC/UNIT** GM-13 Volume- Scientific Notation

BEHAVIORAL OBJECTIVES

Cognitive:

Determine the gallonage and size of reservoir for a given population, using scientific notation and basic principles of multiplication, division, addition and subtraction, when given amounts of water used per individual or unit.

Affective:

Desire to develop in others the idea that the water supply problem is for all people in the world, not just certain area populations. (Scientists from all nations are working together on this problem.

Skills Used:

1. Scientific Notation
2. Volume

STUDENT–CENTERED LEARNING ACTIVITIES

In-Class:

A. Problems on water supply using scientific notation and volumes.
See worksheet GM-13A.

Outside or Community:

A. Suggestions for group research and reports.
   1. How do we supply water to arid areas? (Use of dams, e.g. 60 years ago the largest dam in the world was in France, 170 feet tall.) Now U.S. has 100 dams taller than this.
   2. What progress is being made to take salt out of ocean water so it will be usable?
   3. How are scientists trying to increase our supply by raising underground water?
   4. What can be done to provide pure water for our largest population?
   5. How does industry use water? (Choose a particular industry to investigate.)
   6. As an individual, what can I do to use our water supply more wisely?
   7. What data and statistics can you use to help others in your family, school and community realize our water problems?

(Continued)

SUGGESTED RESOURCES

Publications:

This Thirsty World,
Lewis, Alfred,
McGraw-Hill, 1964.

Audio–Visual:

Water Around Us, 22 minutes,
#2903, BAVI.
Problems of Conservation: Water,
16 minutes, #2376, BAVI.
Simulation Game: SG 3 Dirty Water -
The Water Pollution Game,
Urban Systems, Inc. 1970, I-C-E RMC.
Book: Freshwater Ecology
by Andrews, I-C-E RMC.

Community:

City Water Plant
Industry, eg. Paper Company using
water.

CONTINUED OR ADDED LEARNING ACTIVITIES

OUTSIDE: (Continued)

B. Field trip to some industry to see how water is used.
(e.g. paper mill)
C. Visit the city water plant.
D. Make a poster or cartoon on some water problem and display
it in the school to make others realize our water problem.

Worksheet GM-13A

1. If each person alive can receive a lake of water 10 miles (52,800 ft.) long, 5 miles (26,400 ft.) wide, and 10 ft. deep, how many cubic feet of water would each person receive? Write 15 zeros after this answer. This will represent the world water supply. Write this in scientific notation.

2. Industry is the biggest water polluter, representing 60% of the polluted water. Cities are second worst, pouring out 25% of the polluted water. Finally, agriculture is third with chemical and fertilizer run-off and soil erosion, representing 15%. If the U.S. pours out 50 billion gallons of polluted water each year, how much does each of the major polluters contribute? Express your answers in scientific notation.

3. Facts: It takes 7.5 gallons to make one cubic foot of water. It takes 50 gallons of water to grow a single corn plant. It takes 1,000 gallons of water to produce one quart of milk. It takes 100,000 gallons of water to produce one automobile. Express each of these in cubic feet.

4. In problem 3, if you are given a tank 2 feet by 3 feet, how deep will the water level be for each amount of water?

Answers to GM-13A

1. 13,939,200,000 cubic feet
   13,939,200,000,000,000,000,000,000 cubic feet
   1.39392×10^{25} cubic feet

2.

30,000,000,000	industry	3×10^{10}
12,500,000,000	cities	1.25×10^{10}
7,500,000,000	farms	7.5×10^{9}

3. 6 2/3 cubic feet - corn
   133 1/3 cubic feet - milk
   13,333 1/3 cubic f - car

4. 1 ft. 2 in. or 1 1/6 ft. - corn
   22 ft. 4 in. or 22 1/3 ft. - milk
   2,222 ft. 4 in. or 2,222 1/3 ft. - car

E. S. E. A. Title III – PROJECT I–C–E 59–70–0135–4

Environmental:

CONCEPT NO. 5 - Air

ORIENTATION Clean Air

Integrated with:

SUBJECT General Math

TOPIC/UNIT GM-14 Scientific Notation and Division

BEHAVIORAL OBJECTIVES

Cognitive:

Identify factors which cause air pollution. Prepare possible partial solutions, through individual action, to air pollution. Use mathematic calculations to indicate the more CO_2 is being produced in a given area than is converted.

Affective:

Alert others to the problems created by air pollution. Advocate a need for constant attention to the problem of air pollution, not just when conditions are severe.

Skills Used:

1. Scientific notation
2. Division decimals

STUDENT–CENTERED LEARNING ACTIVITIES

In-Class:

A. Worksheet GM-14A. Problems involving scientific notation and division. These problems refer to air pollution. You may want a class discussion on clean air before you start the problems.

Outside or Community:

A. As a group of 2-3, students will survey the number of people riding in cars to work at noon or after 4:00 P.M.

B. From newspapers and magazine articles, prepare a chart to show amount of pollution from:
   1. Transportation
   2. Factories
   3. Homes

   Students form 2 groups. Each group will be assigned a specific city to analyze according to the criteria presented above.

C. Choose one air pollution problem. Do some research in the library and report to the class later.

D. Perhaps an outside teacher, parent or businessman who has lived in Los Angeles or some large city could talk to the class about air pollution.

(Continued)

SUGGESTED RESOURCES	CONTINUED OR ADDED LEARNING ACTIVITIES
Publications: Pollution, Wisconsin Dept. of Public Instruction. **Audio–Visual:** Air Pollution: Take a Deep Deadly Breath, 54 minutes, color, free. The Poisoned Air, 50 minutes, color, National Medical Audio-Visual Center, Chamblee, Ga. 30005. Simulation Game: SG-1 The Air Pollution Game, Urban Systems, Inc. 1970, I-C-E RMC. Film: The 2nd Pollution, color, 22 minutes, #460, I-C-E RMC. **Community:** City Director of Public Works Business leaders of community	OUTSIDE: (Continued) E. Have city's Director of Public Works give a talk to class on sources of air pollution in the city. F. Contact City of Green Bay for information on Air Monitering devices in use.

Continued and Additional Suggested Learning Experiences

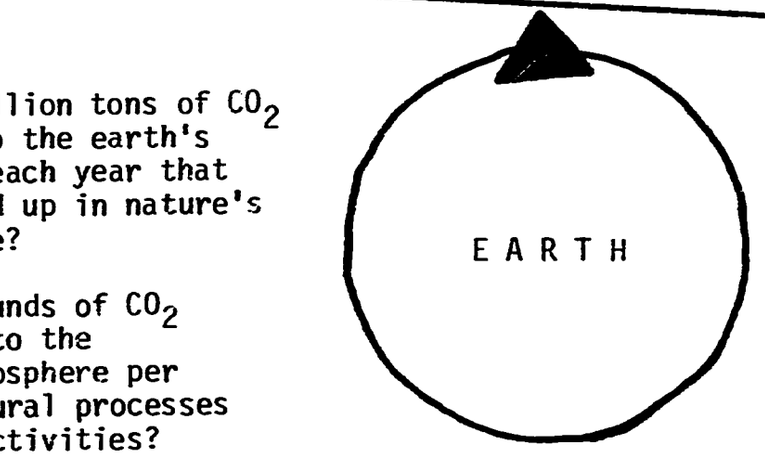
EARTH'S ATMOSPHERE'S CO_2 BUDGET
(UNBALANCED!)

1.

Decrease	
60×10^9 tons	(plants)
100×10^9 tons	(photosynthesis and decay of ocean plants and animals)
100×10^6 tons	(washed by rainfall)

Increase	
60×10^9 tons	(respiration of land plants and animals)
100×10^9 tons	(released from ocean where dissolved)
100×10^6 tons	(volcanoes and hot springs)
6×10^9 tons	(burning fuels--homes, factories, cars, trains, ships, airplanes, etc.)
$2 = 10^9$ tons	(plowing soil)

In the following problems, put answers in scientific notations, also.



a. How many billion tons of CO_2 are added to the earth's atmosphere each year that are not used up in nature's normal cycle?

b. How many tons of CO_2 are taken out of the earth's atmosphere per year by natural processes?

c. How many pounds of CO_2 are put into the earth's atmosphere per year by natural processes and man's activities?

d. Do land plants use more CO_2 from the air than volcanoes put into the air?

Worksheet GM-14A (Continued)

SPECIAL PROBLEMS:

2. Aggravated by air pollutants, emphysema is the fastest growing cause of death in our country today. In the ten-year period from 1950 through 1959, deaths among males from emphysema rose 1.5 per hundred thousand to 8 per hundred thousand. This total has increased steadily. In 1970, the population of the U.S. was 203 million and 50,000 persons died from emphysema. How many people per hundred thousand died from emphysema?

3. In 1949, New York City had the most polluted air and the highest death rate from pneumonia in the state of N.Y.....31.5 per 100,000 population. In 11 upstate cities with much cleaner air, the rate was only 23.9 per 100,000. In rural areas, where pollution was least, the death rate was lower still...16.9. In 1959, all rates increased. Then N.Y. City had 50.6 pneumonia deaths per 100,000; the upstate cities had 38.6 and rural areas had 29.2.
   a. What was the rate of increase in N. Y. City 1949-1959?
   b. How much higher was the rate in N. Y. City than the rural areas in 1949?
   c. What was the rate of increase in the upstate cities from 1949-1959?
   d. How much higher was the rate in N. Y. City than the rural areas in 1959?

4. When the sulfur dioxide content of the air in N. Y. City rises above .2 parts per million, 10 to 20 people die as a result. In the 5 years, 1965-1970, sulfur dioxide reached this level once every 10 days.
   a. What was the minimum number of people who died in N. Y. City during the 5 years from sulfur dioxide?
   b. What was the maximum number.

5. Air pollution in United States costs us the following:
   Respiratory disease, 122 billion
   Cancer, 390 million
   Cardiovascular disease, 470 million

   Put these in scientific notation.

Answers to GM-14A

1. Chart
   a. 8 billion or 8×10^9
   b. 160,100,000,000 1.601×10^{11}
   c. 336,200,000,000,000 3.362×10^{14}
   d. Yes

2. Approx. 24.6 per 100,000

3. a. 19.1 per 100,000
   b. 14.6 per 100,000
   c. 14.7 per 100,000
   d. 21.4 per 100,000

4. a. 1826 min. people
   b. 3652 max. people

5. a. 1.22×10^{11}
   b. 3.9×10^8
   c. 4.7×10^8

E. S. E. A. Title III – PROJECT I–C–E 59–70–0135–4

Environmental:

Integrated with:

CONCEPT NO. 4 - Water

SUBJECT General Math

ORIENTATION Water Supply

TOPIC/UNIT GM-15 Graphing

BEHAVIORAL OBJECTIVES

Cognitive:

Compile data and make a bar or line graph indicating use of water by individuals; communities, as a result of research. Predict the water needs of a community for a given period.

Affective:

Satisfaction in making a worthwhile conclusion and recommendation for future conservation or wise use of water.

Skills Used:

1. Graphing points.

STUDENT–CENTERED LEARNING ACTIVITIES

In-Class:

A. Worksheet GM-15A. Problems involving water usage.

Outside or Community:

A. Visit water department of community to secure information from records on water demands at different times of the year.
B. Observe well drilling operations.
C. Make rain gauges and chart information for several months.
D. Go to nearest weather station and get their data to compare with that gathered by the students.

SUGGESTED RESOURCES	CONTINUED OR ADDED LEARNING ACTIVITIES
Publications: 140 So Soil Conservation Society of America, Water Use: Principles and Guidelines for Planning and Management in Wisconsin, I-C-E RMC. 140 Ecological Effects of Hot Water Discharged by an Electric Power Generating Plant, Univ. of North Carolina, National Sci. Foundation, Asheville, N.C., 1971, I-C-E RMC. **Audio—Visual:** City Water Supply, #0433, BAVI. Water Supply, #2384, BAVI. Water, #3394, BAVI. Conserving Our Water Resources Today, #5367, BAVI. Film: The Gifts, color, 30 minutes, I-C-E RMC. **Community:**	

Worksheet GM-15A

Near Eau Claire, Nebraska, there is an underground reservoir. The following table gives the amount of water in the reservoir since 1900.

1900	50,000,000,000 cu. ft.
1910	46,300,000,000 cu. ft.
1920	42,500,000,000 cu. ft.
1930	38,800,000,000 cu. ft.
1940	35,100,000,000 cu. ft.
1950	31,500,000,000 cu. ft.
1960	27,800,000,000 cu. ft.
1970	24,100,000,000 cu. ft.

Plot the data and draw a line through the points. Answer the following questions:

a. What will be the amount of water in the reservoir in 2000, assuming the present trend continues?

b. What year (nearest whole year) will the reservoir be emptied?

The average American uses 60 gallons of water per day in the home. The percentage breakdown is the following:

Flushing toilets	41%
Washing and bathing	37%
Kitchen use	6%
Drinking water	5%
Washing clothes	4%
General Household Clean.	3%
Watering the garden	3%
Washing the car	1%

a. Make a bar graph.

Answers to GM-15A

a. 13,000,000,000 cu. ft.

b. Year 2035

E. S. E. A. Title III – PROJECT I–C–E 59–70–0135–4

Environmental: **Integrated with:**

CONCEPT NO. 3 Carrying Capacity **SUBJECT** General Math

ORIENTATION Population Growth **TOPIC/UNIT** GM-16 Rounding Numbers and Line Graphs

BEHAVIORAL OBJECTIVES

Cognitive:

Construct a line graph to show population trends, given population statistics. Graph the predicted population trend if a given change in conditions occurs. Predict the type of environmental problem(s) that will probably result as the population trend continues in a given area.

Affective:

Desires ways of getting persons to be concerned about ways of providing food and healthful environment for our people. Study population trends in the world to determine if available food supply per area is sufficient to feed all the people in the area for a given projected time period.

Skills Used:

1. Graphs
2. Percents
3. Approximate numbers
4. Comparisons

STUDENT–CENTERED LEARNING ACTIVITIES

In-Class:

A. Worksheet GM-16A - Drawing a line graph of world population and U. S. population.

B. Class discussion on problems created by our increased population.
   1. How can we supply food for everyone?
   2. Are we planning ahead to conserve natural resources?
   3. As individuals, what can we do to help solve problems such as water pollution and traffic congestion?

Outside or Community:

A. Since it is difficult to understand large numbers, solve this problem using 800 million as the population of China. Each person is reduced to fit one square which he needs to live. Then each person is required to stand on 1/100 square inch of graph paper. The floor of this classroom is covered with graph paper. How many classrooms this size are needed to accommodate all the people in China?

B. Allowing one square foot per person and 3.7 billion people in the world today, could they all stand on Lake Winnebago (30 miles by 10 miles) when it is covered with ice?

C. Because of our population problem, the instructor will have the following speakers come to class to talk on the conservation of natural resources:
   1. Biologist (high school instructor).
   2. DNR representative.
   3. City nurse.

SUGGESTED RESOURCES	CONTINUED OR ADDED LEARNING ACTIVITIES

Publications:

U.S. News and World Report,
March 6, 1972.
110 Co Populations,
Science Curriculum Improvement Study,
I-C-E RMC.
Simulation Game:
SG 4 Man In His Environment,
The Coca-Cola Company, 1970,
I-C-E RMC.

Audio-Visual:

Film:
Food or Famine, Shell Oil Company,
28 minutes, color, free or loan.
Population Problem: U.S.A., Seeds
of Change, $4.50, #6937, BAVI.
Standing Room Only,
$11.00, #6947, BAVI.
Challenge to Mankind,
$4.75, #0330, BAVI.
Filmstrip:
Kit 14, Numbers 1 and 2, I-C-E RMC,
CESA 9, Population Statistics (1)
Population Trends (2)

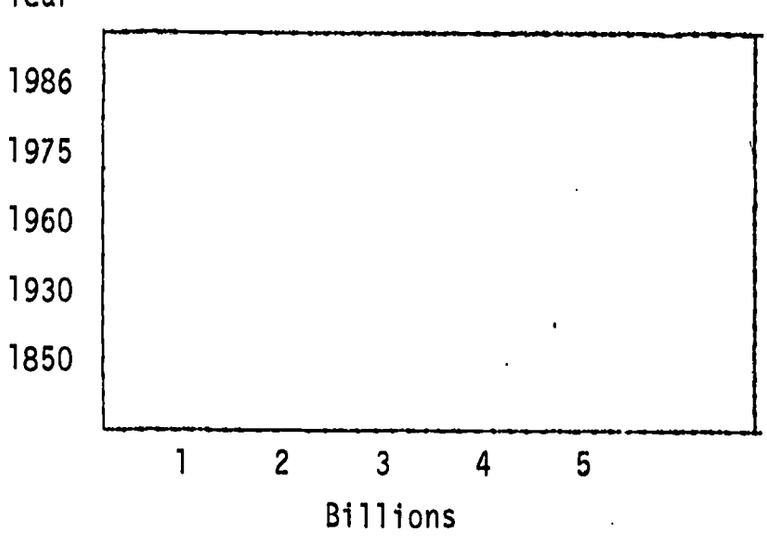
Community:

Biologist (high school instructor)
DNR representative
City nurse

Worksheet GM-16A

1. Consider these statistics on world population:

Birth of Christ	250 million
1850	1 billion
1930	2 billion
1960	3 billion
1975 (estimate)	4 billion
1986 (estimate)	5 billion



Complete the line graph using the above information.

2. U. S. Population

1790	3,929,214
1810	7,239,881
1830	12,866,020
1850	23,191,876
1870	39,818,449
1890	62,947,714
1910	91,972,266
1930	122,775,046
1950	150,697,361
1970	207,326,000

Round these numbers off to the nearest million and draw a line graph of the information.

3. World Populations (millions)

	1950	1970
Latin America	162	283
Africa	217	344
Asia	1,355	2,056
Oceania	13	19
North America	166	228
Russia	180	243
Europe	392	462

Draw a single graph, using two lines. Use a black line for the 1950 date and a red line for the 1970 date.

(Continued)

Measurement

4. According to an estimate, on July 1, 1969, the population of the United States was 201,921,000 persons.

   a. Rounded to the nearest million, what would the population be?

   b. Rounded to the nearest hundred thousand, what would it be?

5. If the population of the United States in 1960 was 178,464,000, what was the population in 1960 to the nearest million? To the nearest hundred thousand? To the nearest billion? To the nearest hundred million?

Answers to GM-16A

1. Graph

2. 4,000,000
   7,000,000
   13,000,000
   23,000,000
   40,000,000
   63,000,000
   92,000,000
   123,000,000
   151,000,000
   207,000,000

   Graph

3. Graph

4. a. 202,000,000

   b. 201,900,000

5. 178,000,000
   178,500,000
   0,000,000,000 or just 0
   200,000,000